KICKDOWN MECHANISM

RELATED APPLICATIONS

[0001] This application claims the benefit of United States Provisional Patent Application Serial No. 60/518,207, filed November 7, 2003.

FIELD OF THE INVENTION

[0002] The present invention relates generally to a kickdown mechanism for use in a pedal assembly to provide a kickdown feel to an operator of the pedal assembly. More specifically, the present invention relates to the kickdown mechanism having detent members for providing the kickdown feel to the operator of the pedal assembly.

BACKGROUND OF THE INVENTION

[0003] Prior art pedal assemblies generally comprise a pedal housing attached to a vehicle body and a pedal arm pivotally supported by the pedal housing. A series of links and levers, or cables, mechanically connect the pedal assembly to a kickdown device. The kickdown device is used to initiate a kickdown, i.e., a downshift to a next lower gear in an automatic transmission. Typically, such downshifts occur when an operator desires fast acceleration. When the pedal arm is pivoted from an idle position to a predetermined operable position, the kickdown device is mechanically engaged to downshift the automatic transmission. An added force is required to further pivot the pedal arm when the kickdown device is mechanically engaged. This added force provides a sensation to the operator that is commonly referred to as a kickdown feel, i.e., the operator can "feel" when the kickdown device is engaged, and hence, when the automatic transmission downshifts to the next lower gear.

[0004] Consequently, a large amount of packaging space must be provided within the vehicle to accommodate the mechanical connections to the kickdown device. However, the space available for the mechanical connections is limited. Hence, recent improvements in the prior art use electrical connections in place of the mechanical connections. Instead of using the mechanical connections to mechanically transmit a position of the pedal arm to the kickdown device, an electrical

generator is used to electrically transmit the position of the pedal arm to control the kickdown device. Replacing the mechanical connections with electrical connections reduces the necessary packaging space for the pedal assembly.

[0005] Unfortunately, without the mechanical connections, electronic pedal assemblies do not provide the customary feel and performance of a mechanically connected pedal assembly. In other words, the pedal assembly does not provide the kickdown feel to the operator when the downshift occurs, i.e., the user cannot "feel" when the downshift occurs. To solve this problem, manufacturers incorporate a kickdown mechanism in the electronic pedal assembly to provide the kickdown feel to the operator. The kickdown mechanism is markedly different than the kickdown device described above. The kickdown device is mechanically connected to the pedal assembly via a link or cable and mechanically initiates the downshift in the automatic transmission. Conversely, the kickdown mechanism in an electronic pedal assembly does not initiate the downshift. In this instance, the kickdown mechanism is a stand-alone mechanism simply used to simulate the kickdown feel for the operator.

[0006] An example of a kickdown mechanism used in an electronic pedal assembly to simulate a kickdown feel is shown in U.S. Pat. No. 6,418,813 to Lewis. The pedal assembly of Lewis comprises a pedal housing and a pedal arm pivotally engaging the pedal housing. The kickdown mechanism is mounted to the pedal housing. The kickdown mechanism comprises a housing that defines a chamber for receiving a plunger. The plunger defines a detent pocket and is slidable within the chamber when engaged by the pedal arm. A first spring biases the plunger toward the pedal arm. A detent member is movable between an initial position in the detent pocket and a plurality of active positions out from the detent pocket. The detent member moves out from the detent pocket when the plunger is engaged by the pedal arm to provide the kickdown feel. A second spring biases the detent member back to the initial position after the pedal arm is disengaged from the plunger.

BRIEF SUMMARY OF THE INVENTION

[0007] The present invention provides a kickdown mechanism for use with a pedal arm to provide a kickdown feel to an operator of the pedal arm. The kickdown mechanism includes a housing defining a chamber. An operational axis is

defined through the chamber. A resilient member is movable within the chamber along the operational axis. The resilient member presents a bearing surface. A detent member is in contact with the bearing surface and is moveable between an initial position and a plurality of active positions against the bias of the resilient member while maintaining contact with the bearing surface. A force required to move the detent member from the initial position to the plurality of active positions provides the kickdown feel to the operator. An actuator is spaced from the resilient member and engages the detent member to move the detent member from the initial position to the plurality of active positions when engaged by the pedal arm. The kickdown mechanism is characterized by the bearing surface being disposed at an acute angle to the operational axis to urge the detent member back to the initial position under the bias of the resilient member.

[0008] The present invention provides several advantages over the prior art. Notably, the combination of the angled bearing surface and the bias of the resilient member provides a robust kickdown mechanism having a simple configuration. More specifically, by using this combination, a separate spring, such as the second spring of the '813 patent, is not needed to urge the detent member back to the initial position. Instead, the angled bearing surface transfers the bias of the resilient member both axially and radially to the detent member to move the detent member back to the initial position when the pedal arm is disengaged from the actuator.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0009] Advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0010] Figure 1 is a perspective view of a kickdown mechanism of the present invention in a pedal assembly;

[0011] Figure 2 is an exploded view of the kickdown mechanism taken from a left perspective;

[0012] Figure 3 is an exploded view of the kickdown mechanism taken from a right perspective;

[0013] Figure 4A is a cross-sectional view of the kickdown mechanism illustrating detent members in an initial position;

[0014] Figure 4B is a cross-sectional view of the kickdown mechanism illustrating the detent members in an active position;

[0015] Figure 5A is an illustrative view of the kickdown mechanism taken generally along the line 4A-4A to illustrate the detent members in the initial position; and

[0016] Figure 5B is an illustrative view of the kickdown mechanism taken generally along the line 4B-4B to illustrate the detent members in the active position.

DETAILED DESCRIPTION OF THE INVENTION

[0017] Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, a kickdown mechanism for use with a pedal assembly **10** to provide a kickdown feel to an operator of the pedal assembly **10** is generally shown at **12**.

[0018] Referring to FIG. 1, the kickdown mechanism **12** is mounted to the pedal assembly **10**. The pedal assembly **10** comprises a pedal housing **14** and a pedal arm **16** pivotally supported by the pedal housing **14** for moving between an idle position and a plurality of operable positions about an axis **X**. The pedal arm **16** is preferably formed from steel or polymeric material and the pedal housing **14** is preferably made from a polymeric material such as nylon. The kickdown mechanism **12** includes an adjustment device **18**, e.g., threads **18a** and slot **18b**, for adjustably mating with a threaded bore **20** of the pedal housing **14**. The kickdown mechanism **12** is positioned within the threaded bore **20** for actuation by the pedal arm **16**.

[0019] An electrical generator **22** is supported by the pedal housing **14**. The electrical generator **22** generates a control signal that varies in magnitude in proportion to the extent of movement of the pedal arm **16** relative to the pedal housing **14**. The electrical generator **22** is typically a potentiometer. However, other generators or sensors known in the art can be used such as non-contact Hall effect sensors, and the like. When the control signal reaches a predetermined magnitude, a controller (not shown) initiates a kickdown, i.e., downshift of an automatic transmission (not shown) to a next lower gear, as is well known to those skilled in the art. The adjustment device **18** of the kickdown mechanism **12** adjusts a position of the kickdown mechanism **12**

relative to the pedal arm **16** to synchronize the kickdown feel with generation of the control signal at the predetermined magnitude. This synchronizes the kickdown feel with the downshift of the automatic transmission to closely replicate mechanical kickdown devices.

[0020] Referring to FIGS. 2 and 3, the kickdown mechanism **12** includes a housing **24** having an open end **26** and a closed end **28** spaced therefrom. The housing **24** defines a chamber **30** between the ends **26**, **28** and an operational axis **A** through the chamber **30**. The housing **24** and chamber **30** are generally cylindrical in shape. The housing **24** includes a sidewall **32** defining a first **34** and second **36** pair of elongated slots therein. Each of the first pair of elongated slots **34** opens into the open end **26** of the housing **24** and terminates along the sidewall **32** between the ends **26**, **28**. Each of the second pair of elongated slots **36** is fully enclosed by the sidewall **32**. Both pairs of elongated slots **34**, **36** are parallel to the operational axis **A**. The housing **24** is preferably formed from plastic.

[0021] Referring to FIGS. 4A and 4B, a resilient member **37** moves within the chamber **30** along the operational axis **A**. The resilient member **37** comprises a plunger **38** that slides within the chamber **30** along the operational axis **A**. The plunger **38** is generally cylindrical in shape to mate with the generally cylindrical shape of the chamber **30**. The plunger **38** presents first **40** and second **42** bearing surfaces disposed at first α_1 and second α_2 acute angles relative to the operational axis **A**. Preferably, the acute angles α_1, α_2 are between thirty and sixty degrees. More preferably, the acute angles α_1, α_2 are forty-five degrees. The plunger **38** is preferably formed from plastic. The resilient member **37** further comprises a spring **44** disposed within the chamber **30** between the closed end **28** of the housing **24** and the plunger **38** to bias the plunger **38**, i.e., to provide a biasing force of the resilient member **37**. The closed end **28** of the housing **24** includes an embossed portion **46** axially protruding into the chamber **30** along the operational axis **A** and the plunger **38** defines a bore coaxial with the embossed portion **46**. The spring **44** includes a first end seated over the embossed portion **46** and a second end seated with the bore. Thus, the spring **44** biases the plunger **38** axially away from the closed end **28** of the housing **24** and toward the open end **26** along the operational axis **A**. The spring **44** is preferably made from metal such as steel.

[0022] First **54** and second **56** detent members are in contact with the bearing surfaces **40**, **42** of the plunger **38** in the housing **24**. The detent members **54**, **56** are movable between an initial position and a plurality of active positions against the biasing force of the resilient member **37** while maintaining contact with the bearing surfaces **40**, **42**. The detent members **54**, **56** are further defined as rollers **54**, **56**. The rollers **54**, **56** are preferably formed from metal such as steel.

[0023] In the initial position, shown in FIG. 4A, the detent members **54**, **56** are positioned against the bearing surfaces **40**, **42** and within first **58** and second **60** pairs of detent pockets defined in the sidewall **32** of the housing **24**. The bearing surfaces **40**, **42** define a wedge between the detent members **54**, **56**. The wedge urges the detent members **54**, **56** into the initial position, i.e., into the detent pockets **58**, **60**, under the biasing force of the resilient member **37**.

[0024] In the plurality of active positions, one of which is shown in FIG. 4B, the detent members **54**, **56** move out from the detent pockets **58**, **60** against the bias of the plunger **38**. When this occurs, the detent members **54**, **56** move axially and radially along the bearing surfaces **40**, **42** relative to the operational axis **A**. A force is required to move the detent members **54**, **56** out from the detent pockets **58**, **60** and against the biasing force of the resilient member **37**, i.e., from the initial position to the plurality of active positions. This force provides the kickdown feel to the operator.

[0025] Referring to FIGS. 2, 3, 5A, and 5B, each of the detent pockets **58**, **60** are defined by windows **50** formed in the sidewall **32** of the housing **24**. Each of the windows **50** assumes an L-shape or backward L-shape. By cutting such a shape into the sidewall **32** of the housing **24**, as shown in FIGS. 2 and 3, the detent pockets **58**, **60** are formed. Likewise, when these shapes are cut into the sidewall **32**, each of the windows **50** forms a shoulder **64** in the chamber **30**. The shoulders **64** urge the detent members **54**, **56** out from the detent pockets **58**, **60** as the detent members **54**, **56** move from the initial position to the plurality of active positions. In other words, the detent members **54**, **56** must climb the shoulders **64** to move out from the detent pockets **58**, **60**.

[0026] An actuator **66** is disposed within the open end **26** of the housing **24**. The actuator **66** is spaced from the plunger **38** and engages the detent members **54**, **56** to move the detent members **54**, **56** from the initial position to the plurality of active positions, i.e., out from the detent pockets **58**, **60**, when engaged by the pedal arm **16**.

The actuator **66** is slidable within the chamber **30** along the operational axis **A** to move the detent members **54**, **56**. A distance between the actuator **66** and the plunger **38** increases as the detent members **54**, **56** move from the initial positions to the active positions. The actuator **66** includes a front end and a projection **70** disposed thereon for engaging the pedal arm **16**. The projection **70** protrudes from the open end **26** of the housing **24**. The projection **70** is preferably cylindrical in shape with a rounded end **72** that contacts the pedal arm **16**.

[0027] The actuator **66** includes a first pair of guide members **74** for reciprocating within the first pair of elongated slots **34** during operation of the kickdown mechanism **12**. The actuator **66** also includes a second pair of guide members **76** for reciprocating within the second pair of elongated slots **36** during operation of the kickdown mechanism **12**. Each of the second pair of guide members **76** includes a detent tab **78** for springably engaging one of the second pair of elongated slots **36** to retain the actuator **66** within the chamber **30**. The sidewall **32** includes a pair of ramps **80** for guiding the detent tabs **78** into the second pair of elongated slots **36** during assembly. The actuator **66** is preferably formed from plastic.

[0028] The first detent member **54**, the first bearing surface **40**, and the first pair of detent pockets **58** mirror the second detent member **56**, the second bearing surface **42**, and the second pair of detent pockets **60** relative to the operational axis **A**. In other words, the first detent member **54**, the first bearing surface **40**, and the first pair of detent pockets **58** are disposed in an upper portion of the chamber **30** while the second detent member **56**, the second bearing surface **42**, and the second pair of detent pockets **60** are disposed in a lower portion of the chamber **30** equidistant from the upper portion relative to the operational axis **A**. This arrangement balances forces acting within the kickdown mechanism **12** relative to the operational axis **A** to reduce wear and increase the longevity of the kickdown mechanism **12**.

[0029] In operation, the pedal arm **16** engages the actuator **66** when the pedal arm **16** is pivoted to a predetermined operable position from the idle position. More specifically, the pedal arm **16** engages the rounded end **72** of the projection **70** when the pedal arm **16** is pivoted to the predetermined operable position. The force required to press the actuator **66** once engaged by the pedal arm **16** provides the kickdown feel. Preferably, the kickdown feel occurs when the pedal arm **16** achieves

nearly full travel, i.e., close to a maximum travel position. However, other activation points can be utilized.

[0030] FIG. 4A shows the detent members **54**, **56** in the initial position with the pedal arm **16** at the predetermined operable position. In this position, the pedal arm **16** has just engaged the projection **70**, thus initiating the kickdown feel. FIG. 4B shows the pedal arm **16** in the maximum travel position. Here, the downshift has already occurred and the operator has already experienced the kickdown feel via movement of the detent members **54**, **56** from the initial position to the plurality of active positions, i.e., out from the detent pockets **58**, **60**.

[0031] The operator must apply enough force to not only urge the detent members **54**, **56** from the detent pockets **58**, **60**, but to also overcome the biasing effect of the spring **44** on the plunger **38** when moving the pedal arm **16** from the predetermined operable position toward the maximum travel position. When the detent members **54**, **56** are in one of the plurality of active positions and the user releases the pedal arm **16**, e.g., to decelerate, the spring **44** biases the plunger **38**, detent members **54**, **56**, and actuator **66** back toward the pedal arm **16** thereby wedging the detent members **54**, **56** back into the detent pockets **58**, **60**.

[0032] Obviously, many modifications and variations of the present invention are possible in light of the above teachings. The invention may be practiced otherwise than as specifically described within the scope of the appended claims, wherein that which is prior art is antecedent to the novelty set forth in the "characterized by" clause. The novelty is meant to be particularly and distinctly recited in the "characterized by" clause whereas the antecedent recitations merely set forth the old and well-known combination in which the invention resides. These antecedent recitations should be interpreted to cover any combination in which the incentive novelty exercises its utility. In addition, the reference numerals in the claims are merely for convenience and are not to be read in any way as limiting.